Announcements

- EXAM 2 on Tuesday, March 14!
- Homework for tomorrow…

  Ch. 31: CQ 11, Probs. 24, 59, & 60

  CQ6: P_c, P_d, P_a, P_b

  31.10: 2.4 x 10^{-5} m

  31.16: 1.2 Ω

  31.42: 3/8 W

- Office hours…

  MW 10-11 am

  TR 9-10 am

  F 12-1 pm

- Tutorial Learning Center (TLC) hours:

  MTWR 8-6 pm

  F 8-11 am, 2-5 pm

  Su 1-5 pm

Chapter 31

Fundamentals of Circuits

(*Parallel Resistors & Resistor Circuits*)

Review…

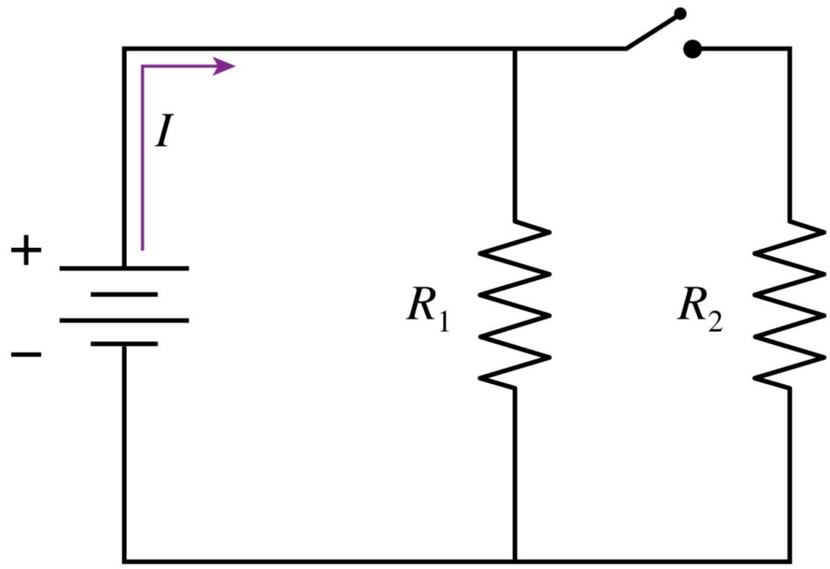
Equivalent resistor for resistors in *parallel*…

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$$

Quiz Question 1

When the switch closes, the battery current

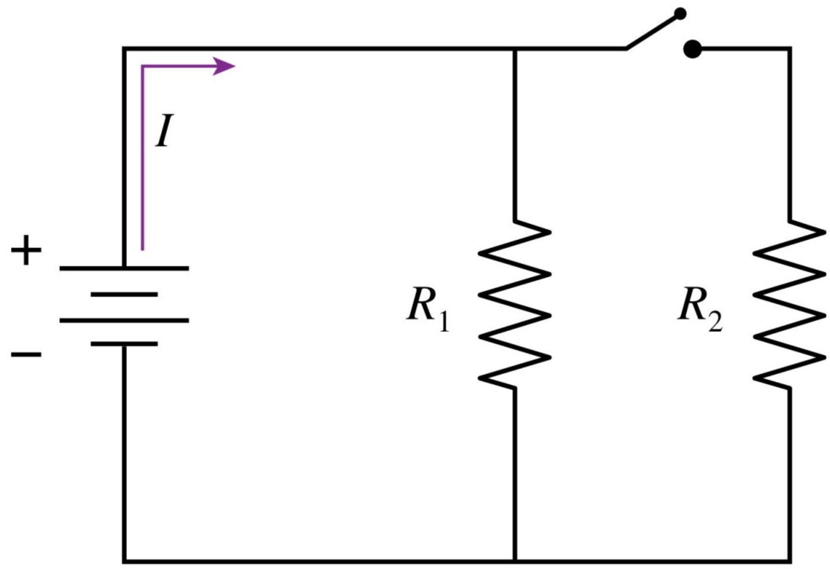
Resistance in parallel goes down compared to I



1. increases.
2. stays the same.
3. decreases.

Quiz Question 1

When the switch closes, the battery current



1. increases.
2. stays the same.
3. decreases.

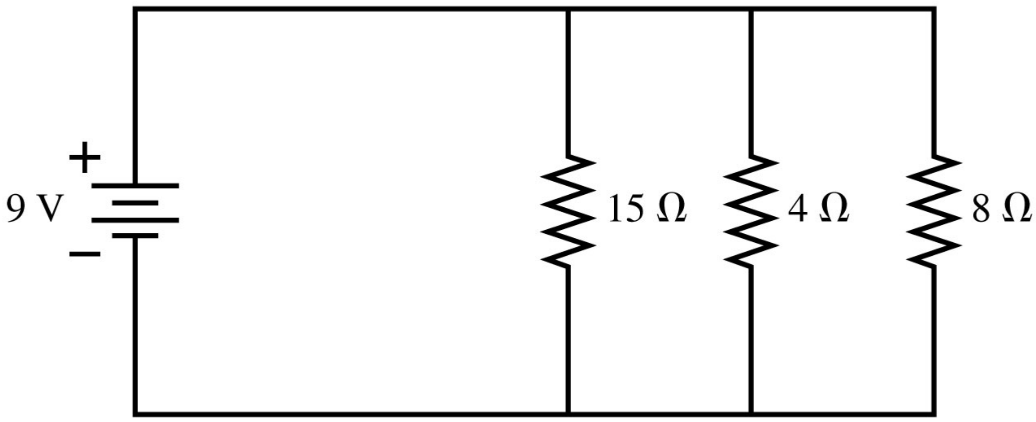
Notice:

The equivalent of several resistors in parallel is *always less than* any single resistor in the group.

i.e. 31.8:
A parallel resistor circuit

The three resistors of the figure below are connected to a 9V battery.

Find the battery *current* and the *potential difference* across and the *current* through each resistor.

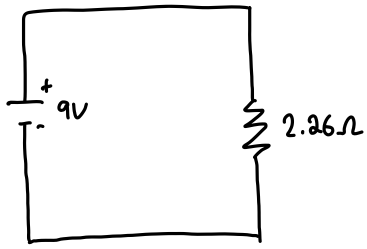


$$\frac{1}{R_{eq}} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$$

$$\frac{1}{R_{eq}} = \left(\frac{1}{15\Omega} + \frac{1}{4\Omega} + \frac{1}{8\Omega}\right)$$

$$\frac{1}{R_{eq}} = \left(\frac{53}{120\Omega}\right)$$

$$R_{eq} = 2.26\Omega$$



$I = \frac{\Delta V}{R}$ $\Delta V = 9V$

$I = \frac{\Delta V}{R}$ $\Delta V = 9v$, $R = 2.26\Omega$

$I = 3.98\ A$

$I \approx 4\ A$

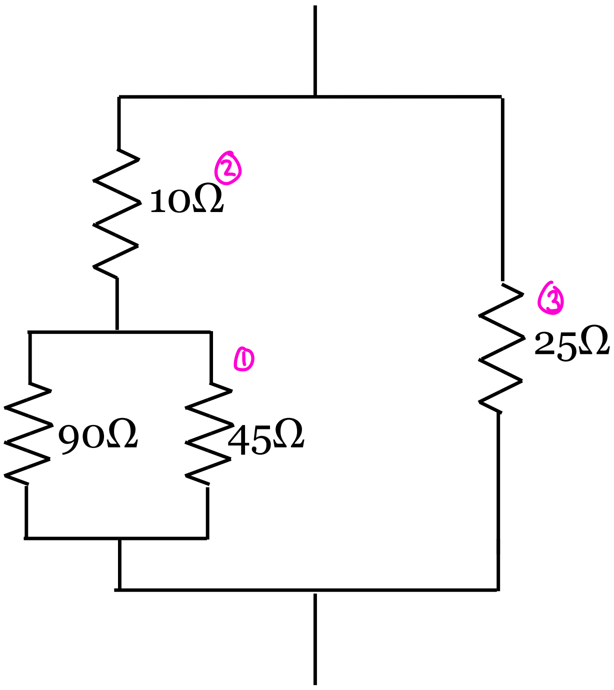
$I_1 = \frac{\Delta V}{R_1}$ $R_1 = 15\Omega$ $I_2 = \frac{\Delta V}{R_2}$ $R_2 = 4\Omega$ $I_3 = \frac{\Delta V}{R_3}$ $R_3 = 8\Omega$

$I_1 = 0.6\ A$ $I_2 = 2.25A$ $I_3 = 1.125\ A$

$\Delta V_1 = 9V$, $I_1 = 0.6A$
$\Delta V_2 = 9V$, $I_2 = 2.25A$
$\Delta V_3 = 9V$, $I_3 = 1.125A$

i.e. 31.9:
A combination of resistors

What is the equivalent resistance of the group of resistors shown in the figure below?



1: $\frac{1}{R_{eq}} = \left(\frac{1}{90\Omega} + \frac{1}{45\Omega}\right)$

$\frac{1}{R} = \left(\frac{1}{30\Omega}\right)$

$R = 30\Omega$

2: 1+2

$30\Omega + 10\Omega$

$R = 40\Omega = 1+2$

(1+2) + (3)

$\frac{1}{R} = \left(\frac{1}{40\Omega} + \frac{1}{25\Omega}\right)$

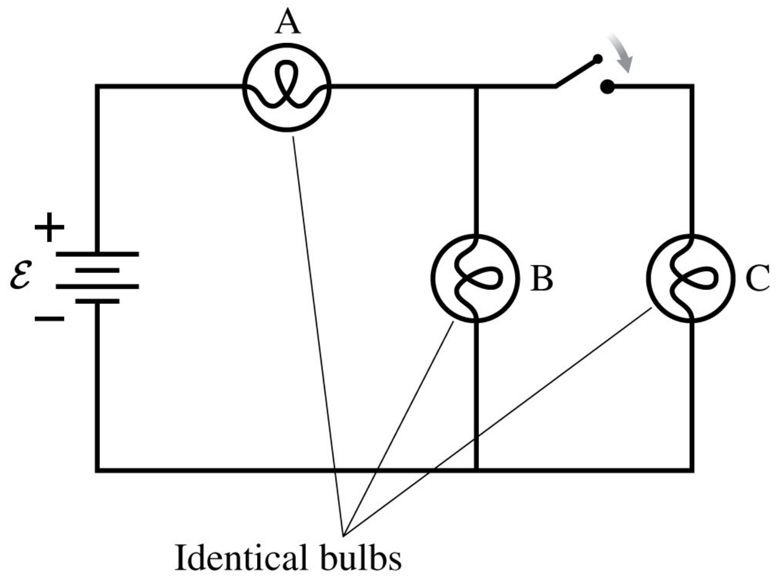
$R = 15.38\Omega$

$\boxed{R = 15.4\Omega}$

Quiz Question 2

Consider the circuit below, where the switch is open. The current is the same through bulbs A and B, and they are equally bright. Bulb C is not glowing.

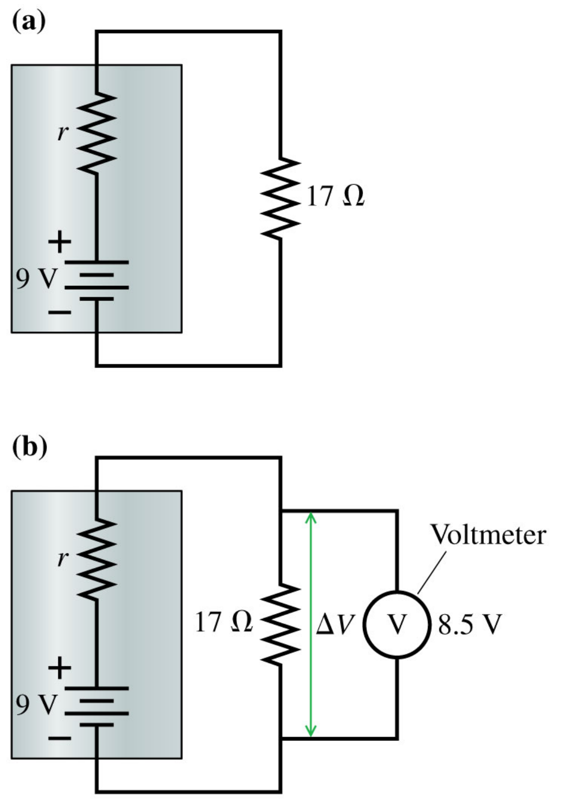
The switch is now closed, what happens to the brightness of B?



1. It increases.
2. It decreases.
3. It stays the same.

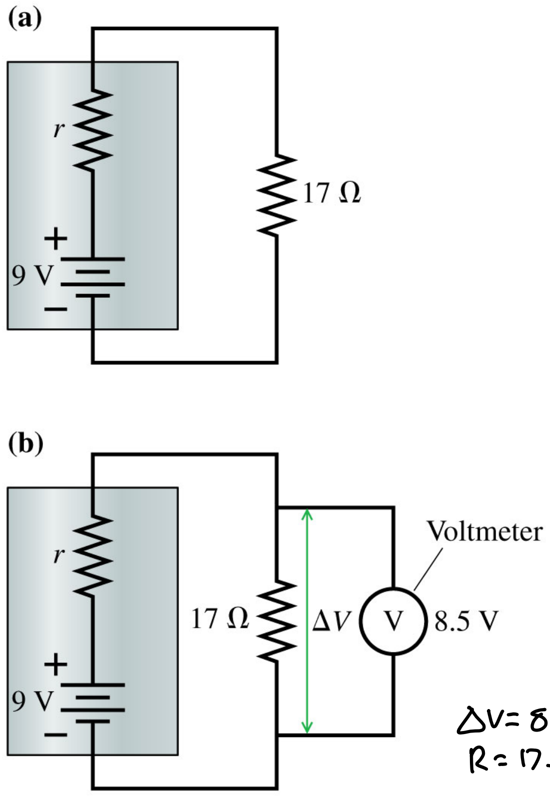
Voltmeters…

- are used to measure *potential differences*.
- Must be wired in *parallel* with the circuit element whose voltage is to be measured.
- $R_{voltmeter} \sim \infty\ \Omega$



i.e.

What is the *internal resistance* of the battery in the figure below?



$\Delta V = 8.5V$

$R = 17\Omega$

$I = \frac{8.5V}{17\Omega} = 0.5A$

$9V - I(r) - 8.5V = 0$

$-Ir = -0.5V$

$r = \frac{0.5V}{0.5A}$

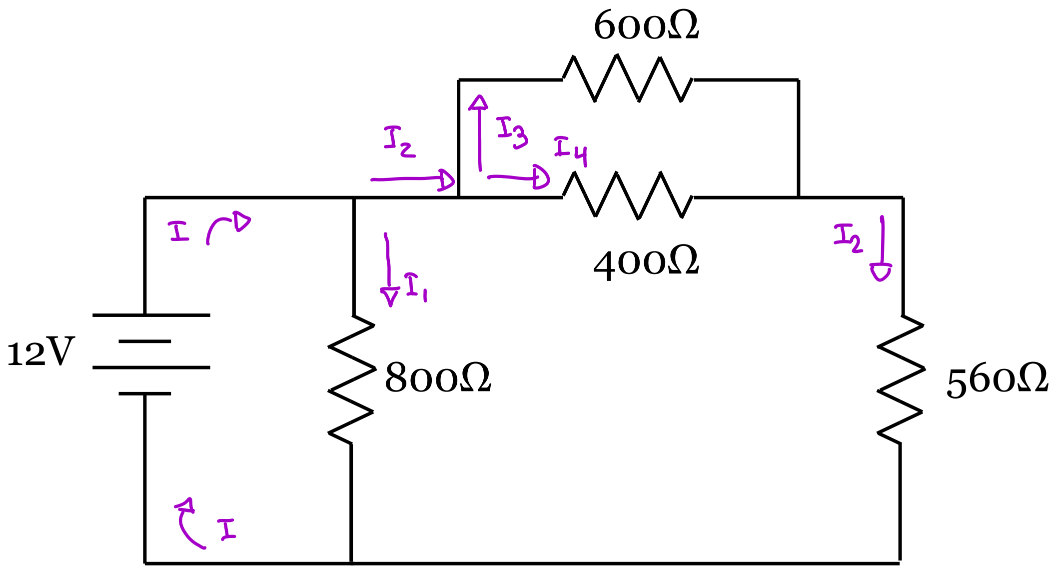
$r = 1\Omega$

Resistor Circuits

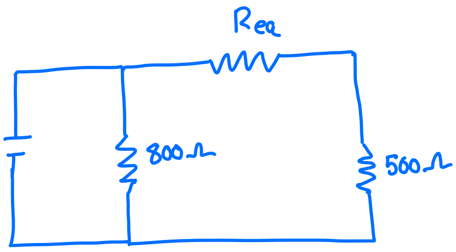
1. Draw a circuit diagram, labeling all known quantities.
2. Reduce circuit to the smallest possible number of equivalent resistors.
3. Write Kirchoff's loop rule for each loop and Kirchoff's junction rule for each junction.
4. Solve the equations and check your results.

i.e. 31.10: Analyzing a complex circuit

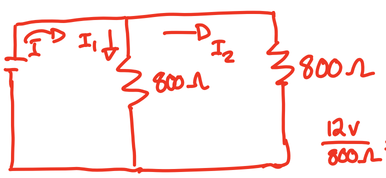
Find the *current through* and the *potential difference across* each of the four resistors in the circuit shown below.



$$R_{eq} = \left(\frac{1}{600\,\Omega} + \frac{1}{400\,\Omega}\right)^{-1} = 240\,\Omega$$



$$R_{eq} + 240\,\Omega = 800\,\Omega$$



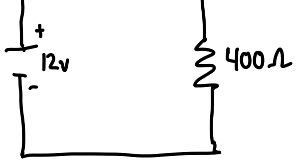
$$R_{eq}' = 400\,\Omega$$

$$\frac{12\,V}{800\,\Omega} = 0.015A$$

$I = I_1 + I_2$

$I_1 = I_2$

$I = 0.03A$



$$I = \frac{\Delta V}{R}$$

$\Delta V = 12v$

$R = 400\,\Omega$

$I = 0.03A$